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ABSTRACT

This paper has been written as a contribution to the resolution 2458 adopted at the 23rd session of the United Nations General Assembly entitled "International Cooperation with a view to the use of computers and computations techniques for development." It is written with a view to the Latin American situation, with the hope that the ideas expressed will apply to other undeveloped areas especially regarding the lack of well-trained people at all levels of society. (Author/AB)

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OBJECTIVE GOALS AND ROLE OF INTERNATIONAL AGENCIES IN COMPUTER SCIENCE EDUCATION IN LATIN AMERICA

BY

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I. INTRODUCTION

This paper has been written as a contribution to the resolution 2458 (XXIII), adopted at the 23rd session of the United Nations' General Assembly, entitled "International co-operation with a view to the use of computers and computation techniques for development".

The author is the Chairman of the Computer Science Department at the Pontifical Catholic University (PUC: Pontifícia Universidade Católica) of Rio de Janeiro. He has been collaborating with the Brazilian National Research Council through a committee intended to establish a program for upgrading computer science and computer science education in Brazil. He has recently participated in a consulting team, sponsored by the Organization of the American States, to survey the computer science status in Latin America.

Due to the author's main concern, this paper is written with a view to the Latin America situation regarding the use of computers. Since the fundamental characteristic of the developing countries seems to be the lack of well-trained people at all levels of society, it is hoped that the ideas expressed in this paper may well apply to other underveloped areas.bb

II. THE STATE OF THE ART

There is no objective way of defining "Computer Science". What computer science is, or should be, still is a matter of arguments, even among experts. However, one thing seems to be generally agreed upon, namely, computer science is not "electronic data processing (EDP)". This distinction, as formal as it looks, must be taken into account in any plan for the development of computer use on a national-wide scale. In Latin America this important distinction is not made at all, with the very few exceptions of some academic institutions. Computer science and EDP at the universities will be considered next.

II.1 - Computer Science versus EDP

As was mentioned above, EDP is taken for Computer Science in the great majority of the universities in Latin America. There are university computing centers that are more of a sort of Services Bureaux rather than academic centers. On one hand the people associated with the university usually lacks a good academic training, and on the other hand business and industry are demanding more sofisticated data processing that the services bureaux are not capable of handling. Thus, business and industry resort to the university for the solution of their problems — the kind of problems the academic people can take care of. The vicious circle then starts to work. The university people, doing what should be done by systems analysts at the services bureaux, find themselves motivated by the vast area of computer applications.

The well-established industry-university interaction, that has brought so many benefits to developed countries, very seldom occurs in developing countries. However, computers have become the first vehicle through which industry is turning to the university for having its problems solved.

The influence of business programs in university computing activities has its disadvantages too. Very easily a computing center becomes entirely devoted

to the assistance of the business community at the expenses of establishing a sound computer science group. The "sophisticated EDP" processing taking place in the universities serve their immediate purposes. They fail, however, to accomplish the ultimate goal, namely, education at an advanced level.

II.2 - Computer Science Programs in Latin America

In what follows we give a brief description of the activities of some computing centers (or departments) in Latin America. The list is not intended to be comprehensive. The ones chosen represent, supposedly, outstanding groups in the five countries considered.

Argentina — Computing Center
University of Buenos Aires
Buenos Aires, Argentina

The center has a Ferranti-Mercury computer. There is a plan to acquire a new computer and an IBM/360 model 65 or a GE 635 are seriously being considered.

The Department of Mathematics has a four year undergraduate program that leads to a "Scientific Computation" diploma. This program is mainly oriented towards computer applications rather than Computer Science in general. No Master's degree program is planned at the present time.

Brazil — Department of Informatics
Rio Datacentro
Pontifical Catholic University (PUC)
Rio de Janeiro, Brazil

The University has a Computer Science (Informatics) Department and a Computer Center (Rio Datacentro). The Department and the Center are, in principle, independent, but both have the same direction.

The Center provides computing services for education, research and academic administration. PUC has an IBM 7044, an IBM 1401, an IBM 1130 and a Burroughs 500.

The Department has a Master's degree program in Computer Science that is now in its second year, and the present enrollment in the program is about twenty-five students. The courses presently available are: Advanced Programming, Numerical Analysis I and II, Automata Theory, Design of Assemblers, Data Structures, List Processing, Languages and Compilers, Data Processing Simulation, and Computer Systems. There are also seminars in Artificial Intelligence, Formal Languages, and Graph Theory.

Chile: Computing Center
Faculty of Mathematics and Physical Sciences
University of Chile
Santiago, Chile

The Center has an IBM 360/40 there is no academic program in Computer Science that leads to a degree. There is, however, a five year undergraduate program that leads to a degree in "Mathematical Engineering". This program appears to provide a training opportunity in Computer Science at the undergraduate level.

The office of National Planning of the Chilean government has a plan to establish a "Regional Institute of Computing Sciences". This project consists of two main activities: (1) the training of systems analysts through short courses (3 to 4 months), and (2) a Master's program in Computer Science (18 to 24 months), which will be carried out within the University of Chile.

Mexico: Computing Center
National Polytechnic Institute
Mexico City, Mexico

The Center has a CDC 3150, a CDC 160-A, an IBM 1130, and a PDP-8. They have been offering a Master's degree program in computer science since 1965 and there have been 15 graduates to date. The program lasts for two years and the students must take a minimum of eight one semester courses and write a thesis. However, most students are required to take twelve courses by their supervising professors. The courses presently available are: Programming

Language I and II, Theory of Machines I, II and III, Numerical Analysis I and II, Finite Mathematics I and II, Simulation, Control Theory, Logical Design, Mathematical Programming I and II, Statistics, Econometrics, Operations Research I and II, and Research Techniques and Orientation I and II.

It is also worth mentioning the Computing Center of the Autonomous National University of Mexico. They do not have a standard academic program but, in terms of trained-people and research work, they certainly are among the best groups in Latin America.

Venezuela: Computer Science Department
Central University
Caracas, Venezuela

The Department has an IBM 360/40 which is used for both computer science research and as a service facility for the entire university. This computer together with an IBM 360/30 used by the university administration, will be substituted by an IBM 360/50 in the near future.

The Department started, last year, a degree program in Computer Science at the undergraduate level. The program consists of a core of basic mathematics and programming courses with specialization in the last two semesters. The areas of specialization are numerical analysis, data processing, computer systems, mathematical models, and optimization. There are no specific plans to start a graduate program in Computer Science at the present time.

II.3 - Observations:

The outline above leads to the following conclusions:

(1) there are only two graduate programs that can be strictly considered Computer Science: the one at the Pontifical Catholic University, in Rio, and the one at the National Polytechnic Institute in Mexico City. Both award Master's degrees and have a general philosophy of striking a balance between theoretical content and the pressing need of the countries for trained computer personnel.

(2) there are no doctoral programs in computer science.

(3) there are a number of undergraduate programs oriented to computer applications.

(4) equipment is, in general, well supplied.

III. OBJECTIVE GOALS

In countries where computers are not manufactured, Computer Science development should take place only within the universities. This is particularly true in developing countries, where technological education is badly needed.

A plan aimed at the improvement of computer science on nationalwide scale should have, as its first and most important goal, the formation or improvement of computer science groups (departments or centers) in the leading universities.

To that purpose the following measures are necessary:

(1) select the universities which will participate in the program;

(2) send qualified students abroad to obtain their doctorates;

(3) bring visiting professors and new PhD's for one to two years to the universities selected in (1).

Clearly, a project like that should last for a period not shorter than five years. This is enough time for the University Centers to establish a good masters's degree program and also benefit from the first PhD's returning from abroad. Some more advanced centers might even begin a PhD degree program.

It is essencial that the students going abroad enroll in a doctorate program rather than a master's program. In fact, this program should even encourage the completion of the master's degree in the country of origin. The master's program is a suitable means to improving the EDP environment.

However, as far as computer science goes, the training at the PhD level is mandatory. There is an intimate relation between the stage of development of a science and the numbers of PhD's directly involved. Past experience has shown that in developing countries, research work leading to original contributions succeeds only in those areas of science where a considerable number of PhD' are working on a full time basis.

IV. ROLE OF INTERNATIONAL AGENCIES

It is bad policy to establish general rules for the role of international agencies in developing countries. Different attitudes and different contributions are needed for each country, according to development, geography, historical tradition, and so one. Nevertheless, in regard to technical assistance one might distinguish two different situations:

(1) The countries that know what their needs are.

(2) The ones that do not.

In the first category, the international agencies should leave to the local governments the elaboration of their own development plans. The agencies should encourage and support bilateral programs between the developing countries cooperation are not only psychologically more gratifying but actually more effective. Substantial funds from the agencies should be more available to support exchange of scientists, joint research projects, and fellowship for doctorate studies.

In the second category are the nations that do not know how to go about elaborating their own development plans regarding computer science. In these cases, a team of qualified experts should be sent to the countries for a preliminary survey of the situation. Then, based on the local potentialities, a plan should be elaborated and submitted to the government and international agencies.

Finally, I would like to emphasize once more my strong belief on the PhD training, as a means to change a country's infrastructure, simply by upgrading the scientific and technological education. A Master's program can serve only immediate purposes, but long-term benefits will be provided solely through a sound knowledge of the nation's problems and the technical ability to work out the appropriate solutions.